



IJPPR

INTERNATIONAL JOURNAL OF PHARMACY & PHARMACEUTICAL RESEARCH  
An official Publication of Human Journals

ISSN 2349-7203





Human Journals

Research Article

October 2022 Vol.:25, Issue:3

© All rights are reserved by Firas Najm ABD et al.

## Prevalence of Heterophoria in 6-12 Years School Children in Karbala, Iraq

	
<b>Firas Najm ABD*, Nawras Sameer Ahmed, Ahmed Faisal Abdul Hassain</b>	
<i>Karbala Health Directorate, Public Health Department, Iraq</i>	
<b>Submitted:</b> 23 September 2022	
<b>Accepted:</b> 28 September 2022	
<b>Published:</b> 30 October 2022	

**Keywords:** Heterophoria, Prevalence, Visual acuity, School base, Iraq.

### ABSTRACT

**Background and aim:** the aim of the study was to report the prevalence of heterophoria in Iraqi school-aged children and to examine the association with potential risk factors. **Method:** This cross-sectional study was conducted in Karbala school (Iraq). Participants were selected randomly from grades 1-6<sup>th</sup> primary school in the urban area. Ocular examinations were performed in participants, in near and distance visual acuity and the near and distance fixation cover test was used to differentiate heterophoria. **Result:** Of 802 students that completed all the ocular examinations, the mean age of participants was  $9.22 \pm 1.86$  years and 49.6% (n=400) of them were male. In participants with heterophoria, 152 (19.0%) participants had exophoria, 30 (3.7%) had esophoria, 8 (1.0%) had hypophoria, 4 (0.5%) had hyperphoria. Logistic regression adjusted for gender and visual acuity showed the odds of having heterophoria was 0.9 (95% CI: 0.83, 0.99) time with increasing one year in the age of participants that was statistically significant (P=0.027), in addition, the odds of having heterophoria adjusted with age and gender in participants with visual acuity was 1.57 (95% CI: 1.01, 2.43) time compared with participants without heterophoria that was statistically significant too (P=0.045). **Conclusion:** Our result showed the prevalence of heterophoria was in the mid-range and was similar to undeveloped countries. We suggest the school health Instructor and government administrators should make a greater effort to contribute to the current eye screening program.



[www.ijppr.humanjournals.com](http://www.ijppr.humanjournals.com)

## INTRODUCTION

Heterophoria refers to a situation where both eyes tend to deviate from the parallel form and is mainly caused by the imbalance of binocular extraocular muscle force and the insufficient convergence required. Exophoria and esophoria are the common types of heterophoria that turn the eye outward and inward, respectively, from an active position (1). Heterophoria may have no symptoms in patients, but poorly controlling in heterophoria may lead to extraocular muscle tension, visual fatigue, diplopia, eye pain, blurred vision, dizziness, fatigability and headache, strabismus that may decline in visual function or even severe visual impairment that some time need advance treatment such as surgery (2, 3).

The prevalence of heterophoria reported varies in previous studies in different ethics and geographic regions. The range of heterophoria was from 4.0% to 80.2% (4-10). Recently, many studies have reported the prevalence of strabismus (4-12). But, few kinds of research in the Middle East, especially in Iraq, have been focused on heterophoria.

If heterophoria is not treated at the appropriate time, is the most common cause of uncorrectable visual impairment, difficulties in daily life activities, and reduced quality of life in children and adults up to 60 years old (13). Identifying and treating heterophoria at an earlier age improves the chance of restoring binocularity and may prevent permanent strabismus-associated heterophoria (14). Some studies showed that factors such as age (2, 4, 11, 12), gender (11, 15), ethnicity (5, 11), and refractive error (5, 16-18) have an association with the heterophoria.

Most of the risk factors such as living habits, economic level, education level, and health care coverage for children in Iraq may differ from other countries that the previous study conducted. Hence, this study aimed to report the prevalence of heterophoria in Iraqi school-aged children and to examine the association with potential risk factors.

## METHOD:

This cross-sectional study was conducted in a school-based. Participants were selected from grade 1-6th primary school in Karbala urban area, Karbala, Iraq. All primary schools in Karbala were listed, and 20 schools were selected by the simple randomization method. In each school, 40 students were selected by proportional sampling from each class.

Students with self and parent informed consent were included in the study. Also, exclusion criteria were history of any intraocular surgery, history of any non-surgical treatment for strabismus or phoria including orthoptics, any ophthalmic or systemic medications affecting binocular vision and accommodation, and ocular trauma. All students refer to one of the Karbala health centres to assess the student's eyes.

The logarithm of the minimum angle of resolution (LogMAR) chart was used to measure distance visual acuity. All assessments were measured monocularly at the optimal test distance of 244 cm (8 feet). Distant visual acuity is considered worse than logMAR 0.0 (20/20).

The LogMAR HOTV near vision chart is used to test near vision acuity at 33 cm. A screening phase determined the approximate threshold visual acuity, which was then confirmed. Visual acuity was scored as the smallest optotype seen. Another appointment to retest visual acuity was given to students that incorporated with visual acuity testing on examination day. In addition, cover and uncover test and alternate cover test were used to determine the heterophoria and the type of heterophoria. Also, a training pack was prepared to familiarize students with those rebooked for a visual acuity retest.

### **ETHICAL CONSIDERATION**

Ethical approval for this study was obtained from the ethical committee of Tehran University of medical sciences (TUMS). All procedures used adhered to the tenets of the Declaration of Helsinki. Written and verbal informed consent was obtained from either the parent or guardian of each participant before any examination. All study personnel complied with child protection legislation. Parents who refuse the initial invitation are contacted at a later time in an attempt to recruit them. In addition, no payment was made for medical examinations or transportation by participants.

### **STATISTICAL ANALYSIS**

The outcome and categorical variables were described by number, percentages, and 95% confidence interval (CI); also, mean, standard deviation (SD), and 95% CI were used to describe continuous variables, which are nearly normally distributed. T-test was used to compare the mean of continuous variables in the healthy/heterophoria subgroup, and chi-square was used to evaluate the association of categorical variables with outcome.

Also, odds ratios (OR) and 95% confidence intervals (CI) are reported as a measure of association, the odds ratio of having heterophoria and 95% CI among participants were calculated by uni-variable logistic regression; in addition, the adjusted odds ratio and 95% CI calculated by stepwise multivariable logistic regression. The backward stepwise regression model was used to run the multivariable analysis. Due to the low sample size and keeping the power of statistical analysis high, all types of heterophoria are considered one group (unhealthy). All analyses were performed two-sided, and P-value less than 0.05 was considered statistically significant. IBM® SPSSver25® software was used to analyze the data.

## **RESULT:**

A total of 802 students in grades 1-6 were examined; the response rate among eligible students was 96%, and about 1% of participants had at least one missing data. The mean age of participants was  $9.22 \pm 1.86$  years, and 49.6% (n=400) of them were male.

Totally 194 (24.2%, 95% CI=21.2%, 27.2%) children were diagnosed with heterophoria at near or distance position, in which 152 (19.0%) participants had exophoria, 30 (3.7%) had esophoria, 8 (1.0%) had hypophoria, 4 (0.5%) had hyperphoria. Also, the prevalence of visual acuity in distance position of both eye was about 14% (95% CI: 11.6, 16.4), and 8% (95% CI: 6.1, 9.9) at near position.

Table 1 shows the difference in mean age in normal/abnormal participants. The result showed that the mean age of patients with heterophoria is 0.36 years lower than healthy participants, which was statistically significant (P=0.017). The mean age in participants with visual acuity was 0.43 years lower than healthy participants that were statistically significant (P=0.025).

**Table 1: compare mean age in healthy/unhealthy participants**

	Age in positive patients mean±sd years	Age in negative patients mean±sd years	Age difference (patients-normal) years (95 % CI)	P-value
Heterophoria	8.95 ± 1.85	9.31 ± 1.86	-0.36 (-0.66, -0.06)	0.017
Hypophoria and Hyperphoria	9.17 ± 2.52	9.31 ± 1.86	-0.15 (-1.22, 0.92)	0.788
Esophoria	8.67 ± 2.22	9.31 ± 1.86	-0.65 (-1.33, 0.04)	0.066
Exophoria	8.99 ± 1.72	9.31 ± 1.86	-0.33 (-0.65, 0.00)	0.050
Visual acuity				
Distance	8.85 ± 1.86	9.28 ± 1.85	-0.43 (-0.80, -0.05)	0.025
Near	9.00 ± 1.78	9.24 ± 1.87	-0.24 (-0.72, 0.23)	0.314

Results of adjusted and unadjusted logistic regression for heterophoria and potential risk factors have shown in table 2. Univariable (unadjusted) regression showed that the odds of having heterophoria decreased 10% or 0.9 (95% CI: 0.82, 0.98) time with increasing one year in the age of participants. In other words, the odds of having heterophoria decreased 0.9 times with increasing one year in the age of participants that was statistically significant (P=0.018). Also, the odds of having heterophoria in participants with visual acuity was 1.59 (95% CI: 0.72, 1.37) time compared with participants without heterophoria; in other words, the odds of having heterophoria in patients with visual acuity was 1.59 time of patients without visual acuity that was statistically significant (P=0.035).

Also, adjusted logistic regression adjusted for gender and visual acuity showed the odds of having heterophoria decreased 10% or 0.9 (95% CI: 0.83, 0.99) time with increasing one year in the age of participants that was statistically significant (P=0.027), in addition, the odds of having heterophoria adjusted with age and gender in participants with visual acuity was 1.57 (95% CI: 1.01, 2.43) time compared with participants without heterophoria that was statistically significant too (P=0.045) (Table 2).

**Table 2: adjusted and unadjusted logistics regression to detect the association**

<b>Unadjusted (univariable logistic regression)</b>				
<b>Heterophoria</b>	<b>Odds Ratio</b>	<b>SE</b>	<b>95% of CI (lower, upper)</b>	<b>P-value</b>
Age	0.90	0.04	(0.82, 0.98)	0.018
Gender (female as reference)	0.99	0.26	(0.72, 1.37)	0.964
Visual acuity	1.59	0.22	(1.03, 2.46)	0.035
<b>Adjusted (multivariable logistic regression)</b>				
<b>Heterophoria</b>	<b>Odds Ratio</b>	<b>SE</b>	<b>95% of CI (lower, upper)</b>	<b>P-value</b>
Age	0.90	0.04	(0.83, 0.99)	0.027
Gender (female as reference)	1.03	0.17	(0.74, 1.44)	0.848
Visual acuity	1.57	0.22	(1.01, 2.43)	0.045

## DISCUSSION

More than 802 children were enumerated in this survey of urban, school-aged children in Karbala, Iraq. The overall examination response rate (96%) was outstanding, considering that the study was conducted in a densely populated metropolitan area within representative samples.

To the best of our knowledge, this study is the first to provide school-based data on the prevalence of heterotopia and visual acuity in school-aged children in a large metropolitan area in Iraq (Karbala). Authors of the paper believe their results are reliable and valid because of representative sample size, relatively large number of screened people, covering of all different socio-economic status areas, the whole cities and schools, and data gathering, quality control by researcher project who are a panel member of province Karbala data collection team.

The prevalence of heterophoria in our 802 sample 1-6th grade school children was overall in the mid-range 24.2% (95% CI: 21.2%, 27.2%). Among these students 152 patients (19.0%) had exophoria, 30 (3.7%) participants had esophoria, and 12 patients (1.5%) had hypophoria and hyperphoria (8 patients with hypophoria and 4 patients with hyperphoria).

The result of our study was consistent with the previous studies (5, 8, 19-23). However, it has controversy comparing the prevalence of phoria found in this study to other studies. The large study of Leone et al. that was conducted on 4093 students in Sydney showed the exophoria was highly prevalent at near fixation (age 6: 58.3%, age 12: 52.2%) (5).

The prevalence variations might be attributable to disparities in genetic vulnerability, environmental factors, and lifestyles among the different locations. Also, another factor of this difference could be that studies selected participants from hospitals/institutions.

Also, the result of our study showed the odds of having heterophoria change 0.90 times by increasing one year in the age of participants. However, most studies found no difference in the prevalence of phorias according to gender or age (11, 22, 24-27). However, the result of Hashemi et al. (4) suggested that the prevalence of phoria was significantly higher in older age groups that were consistent with some previous studies (5, 25, 28-30). A trend of the phoria distribution across the age's shows that it's beyond 6 years of age, after the entrance in school, a significant incidence of heterophoria may occur due to changes in the visual system that may be related to the start of school activities (11, 25, 31). Also, some studies reported, from the age of 20, humans become progressively more exophoric for near vision (28, 32) and reach around 5 pd at the 50s and 60s of life (33).

In addition, our result showed that the odds of having heterophoria in participants with visual acuity was 1.59 (95% CI: 0.72, 1.37) time compared with participants without heterophoria. Previous studies had controversy in the evaluation of heterophoria and visual acuity that some study not find an association (16, 34-38) However, some studies found associations between phoria and visual acuity (5, 16-18). In addition, some previous studies reported a weak but significant correlation between phoria and fusional vergence, (8, 27, 39), However, there is some controversy in founding, and some studies found no correlation (32, 33, 40).

The association may be because of the need for greater accommodative efforts to overcome hyperopia, which in conjunction with convergence causes an esodeviation (5). Furthermore, previous literature reported near esophoria may have been associated with the development and increased rates of myopic progression in children (36, 41, 42) and may be related to vergence adaptation to a prolonged exposure to near tasks, which causes a convergence; also, this may even be a possible cause of myopia progression (41, 43).



## **LIMITATION:**

This study has some limitations and should be considered; first, this is a cross-sectional study, and a causal relationship cannot be concluded. Second, information on children and families was collected based on the parent/carrier-reported questionnaire, which carried a risk of recall bias. Third, children who may have been received ophthalmic care from other practicing ophthalmologists, along with those whose heterophoria had been completely treated, might have been absent from the study. This may have lowered the prevalence rate. Finally, last but not least, due to the limited number of cases for each subgroup, we did not have enough power to analyze the risk factors of heterophoria types.

## **CONCLUSION**

Our result showed the prevalence of heterophoria was 24.2%; this value was in the mid-range and was similar to undeveloped countries. We suggest the school health Instructor and government administrators should make a tremendous effort to contribute to the current eye screening program, especially in students in 1<sup>st</sup> and 2<sup>nd</sup> grade of school.

## **ACKNOWLEDGEMENT**

The authors thank the support from the department of education and the Karbala City government for helping to organize the survey. We also thank the school staff, participants, and their parents for their cooperation in conducting this study.

## **CONFLICT OF INTEREST**

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

## **FOUND**

No grants were received for this study.

## **REFERENCES**

1. D. D. Heterophoria. *Optom Vis Sci* 1990;67(6):456-460. 1990.
2. Yekta A, Pickwell L, Jenkins T. Binocular vision, age and symptoms. *Ophthalmic and Physiological Optics*. 1989;9(2):115-20.
3. Wright KW, Spiegel PH, Hengst T. *Pediatric ophthalmology and strabismus*: Springer Science & Business Media; 2013.



4. Hashemi H, Nabovati P, Yekta A, Ostadimoghaddam H, Behnia B, Khabazkhoob M. The prevalence of strabismus, heterophorias, and their associated factors in underserved rural areas of Iran. *Strabismus*. 2017;25(2):60-6.
5. Leone JF, Cornell E, Morgan IG, Mitchell P, Kifley A, Wang JJ, et al. Prevalence of heterophoria and associations with refractive error, heterotropia and ethnicity in Australian school children. *British journal of ophthalmology*. 2010;94(5):542-6.
6. Sandfeld L, Weihrauch H, Tubæk G, Mortzos P. Ophthalmological data on 4.5-to 7-year-old Danish children. *Acta ophthalmologica*. 2018;96(4):379-83.
7. Vilela MA, Castagno VD, Meucci RD, Fassa AG. Asthenopia in schoolchildren. *Clinical Ophthalmology (Auckland, NZ)*. 2015;9:1595.
8. Costa Lança C, Rowe FJ. Variability of fusion vergence measurements in heterophoria. *Strabismus*. 2016;24(2):63-9.
9. Junghans B, Kiely PM, Crewther DP, Crewther SG. Referral rates for a functional vision screening among a large cosmopolitan sample of Australian children. *Ophthalmic and Physiological Optics*. 2002;22(1):10-25.
10. Larsson E, Holmström G, Rydberg A. Ophthalmological findings in 10-year-old full-term children—a population-based study. *Acta ophthalmologica*. 2015;93(2):192-8.
11. Chen AH, O'Leary DJ, Howell ER. Near visual function in young children. Part I: Near point of convergence. Part II: Amplitude of accommodation. Part III: Near heterophoria. *Ophthalmic and Physiological Optics*. 2000;20(3):185-98.
12. Yekta A, Jenkins T, Pickwell D. The clinical assessment of binocular vision before and after a working day. *Ophthalmic and Physiological Optics*. 1987;7(4):349-52.
13. Donahue SP, Arnold RW, Ruben JB. Preschool vision screening: what should we be detecting and how should we report it? Uniform guidelines for reporting results of preschool vision screening studies. *Journal of American Association for Pediatric Ophthalmology and Strabismus {JAAPOS}*. 2003;7(5):314-6.
14. Friedman DS, Repka MX, Katz J, Giordano L, Ibrionke J, Hawse P, et al. Prevalence of amblyopia and strabismus in white and African American children aged 6 through 71 months: the Baltimore Pediatric Eye Disease Study. *Ophthalmology*. 2009;116(11):2128-34. e2.
15. Gupta N, Narang R, Khurana A, Parmar I, Ahluwalia B. Exophoria and refractive errors-evaluation of 250 cases. *Indian journal of ophthalmology*. 1987;35(4):204.
16. Lai L-J, Hsu W-H, Kuo C-N, Hong R-M, Chen M-Y. The Relationship between Myopia and Ocular Alignment among Rural Adolescents. *Open Journal of Preventive Medicine*. 2014;4(11):834.
17. Labarrere CA, Woods J, Hardin J, Campana G, Ortiz M, Jaeger B, et al. Early prediction of cardiac allograft vasculopathy and heart transplant failure. *American Journal of Transplantation*. 2011;11(3):528-35.
18. Akpe BA, Dawodu OA, Abadom EG. Prevalence and pattern of strabismus in primary school pupils in benin city, Nigeria. *Nigerian Journal of Ophthalmology*. 2014;22(1):38-43.
19. Zwierko T, Puchalska-Niedbał L, Krzepota J, Markiewicz M, Woźniak J, Lubiński W. The effects of sports vision training on binocular vision function in female university athletes. *Journal of human kinetics*. 2015;49:287.
20. Mathebula S, Sheni D, Oduntan A. Distribution of heterophoria among primary school children of South Africa. *S Afr Optom*. 2002;61:48-54.
21. Aring E, Grönlund MA, Andersson S, Hård A-L, Ygge J, Hellström A. Strabismus and binocular functions in a sample of Swedish children aged 4–15 years. *Strabismus*. 2005;13(2):55-61.
22. Letourneau J, Giroux R. Nongaussian distribution curve of heterophorias among children. *Optometry and vision science: official publication of the American Academy of Optometry*. 1991;68(2):132-7.
23. Dowley D. Heterophoria. *Optometry and vision science: official publication of the American Academy of Optometry*. 1990;67(6):456-60.
24. Jackson S, Harrad R, Morris M, Rumsey N. The psychosocial benefits of corrective surgery for adults with strabismus. *British Journal of Ophthalmology*. 2006;90(7):883-8.
25. Jimenez R, Pérez M, García J, González MD. Statistical normal values of visual parameters that characterize binocular function in children. *Ophthalmic and Physiological Optics*. 2004;24(6):528-42.
26. Abdi S, Lennerstrand G, Pansell T, Rydberg A. Orthoptic findings and asthenopia in a population of Swedish schoolchildren aged 6 to 16 years. *Strabismus*. 2008;16(2):47-55.

27. Scobee RG, Green EL. Relationships between lateral heterophoria, prism vergence, and the near point of convergence. *American journal of ophthalmology*. 1948;31(4):427-41.
28. Walline JJ, Mutti DO, Zadnik K, Jones LA. Development of phoria in children. *Optometry and vision science: official publication of the American Academy of Optometry*. 1998;75(8):605-10.
29. Anderson H, Stuebing KK, Fern KD, Manny RE. Ten-year changes in fusional vergence, phoria, and nearpoint of convergence in myopic children. *Optometry and vision science: official publication of the American Academy of Optometry*. 2011;88(9):1060.
30. Abraham NG, Srinivasan K, Thomas J. Normative data for near point of convergence, accommodation, and phoria. *Oman journal of ophthalmology*. 2015;8(1):14.
31. Birnbaum MH. *Optometric management of nearpoint vision disorders*: Butterworth-Heinemann; 1993.
32. Weymouth FW, Brust PR, Gobar FH. Ocular muscle balance at the reading distance and certain related factors. *Optometry and Vision Science*. 1963;40(9):504-19.
33. ETEZAD RM, SAGHEB HS, DANESHYAR A. Normative values for the fusional amplitudes and the prevalence of heterophoria in adults (Khatam-Al-Anbia Eye Hospital-2009). 2010.
34. Methling D, Jaschinski W. Contrast sensitivity after wearing prisms to correct for heterophoria. *Ophthalmic and Physiological Optics*. 1996;16(3):211-5.
35. Evans BJ. Optometric prescribing for decompensated heterophoria. *Optometry in Practice*. 2008;9(2):63.
36. Goss DA. Variables related to the rate of childhood myopia progression. *Optometry and vision science: official publication of the American Academy of Optometry*. 1990;67(8):631-6.
37. Goss DA, Zhai H. Clinical and laboratory investigations of the relationship of accommodation and convergence function with refractive error. *Documenta ophthalmologica*. 1994;86(4):349-80.
38. Myklebust A, Riddell P. Fusional stamina: an alternative to Sheard's criterion. *Scandinavian Journal of Optometry and Visual Science*. 2016;9(2):1-7.
39. Radaković M, Ivetić V, Naumović N, Čanadanović V, Stankov B. Heterophoria and fusional convergence and divergence in preschool children. *Medicinski glasnik*. 2012;9(2).
40. Rowe FJ. Fusional vergence measures and their significance in clinical assessment. *Strabismus*. 2010;18(2):48-57.
41. Conway ML, Thomas J, Subramanian A. Is the aligning prism measured with the Mallett unit correlated with fusional vergence reserves? 2012.
42. Chung KM, Chong E. Near esophoria is associated with high myopia. *Clinical and Experimental Optometry*. 2000;83(2):71-5.
43. Sreenivasan V, Irving EL, Bobier WR. Effect of heterophoria type and myopia on accommodative and vergence responses during sustained near activity in children. *Vision Research*. 2012;57:9-17.